ISSN 0704-3716

Canadian Translation of Fisheries and Aquatic Sciences

No. 5167

Study on the several chemical tests for estimating the quality of canned product
II. On the canned sardine and masu-salmon

H. Iida, K. Nakamura, T. Tokunaga, K. Sato,
C. Hoshino, S. Terano, and T. Furukawa

Original title: [illegible]Kanzume no Kagakuteki Hinshitsu Hyoka-ho no Kento - II. Maiwashi. Sakura-Masu Seihin ni tsuite

In: Bull. Tokai Reg. Fish. Res. Lab. (107): 11-23, 1982

Original language: Japanese

Available from:

Canada Institute for Scientific and Technical Information
National Research Council
Ottawa, Ontario, Canada K1A 0S2

1985

28 typescript pages

Fisheries & Oceans
LIBRARY

DEC 15 1986

BIBLIOTHÈQUE
Pêches & O[illegible]

90-00075/

Secretary of State / Secrétariat d'État

MULTILINGUAL SERVICES DIVISION – DIVISION DES SERVICES MULTILINGUES

TRANSLATION BUREAU BUREAU DES TRADUCTIONS

LIBRARY IDENTIFICATION – FICHE SIGNALÉTIQUE

CTFAS 5167

Translated from - Traduction de	Into - En
Japanese	English

Author - Auteur

Haruka IIDA, Kōji NAKAMURA, Toshio TOKUNAGA, Kooichi SATŌ, Chimaki HOSHINO, Shigezō TERANO and Takeshi FURUKAWA

Title in English or French - Titre anglais ou français

Study on the Several Chemical Tests for Estimating the Quality of Canned Product - II On the Canned Sardine and Masu-Salmon.

Title in foreign language (Transliterate foreign characters)
Titre en langue étrangère (Transcrire en caractères romains)

Bin • Kanzume no Kagakuteki Hinshitsu Hyōka-hō no Kentō - II
Maiwashi • Sakura-Masu Seihin ni tsuite.

Reference in foreign language (Name of book or publication) in full, transliterate foreign characters.
Référence en langue étrangère (Nom du livre ou publication), au complet, transcrire en caractères romains.

Tōkai Suisan Kenkyū-jo Hōkoku

Reference in English or French - Référence en anglais ou français

Bulletin of the Tōkai Region Fisheries Research Laboratory

Publisher - Éditeur	DATE OF PUBLICATION / DATE DE PUBLICATION			Page Numbers in original / Numéros des pages dans l'original
Tōkai-ku Suisan Kenkyū-jo	Year / Année	Volume	Issue No. / Numéro	11 - 23
Place of Publication / Lieu de publication				Number of typed pages / Nombre de pages dactylographiées
Japan	1982		107	28

Requesting Department / Ministère-Client: Department of Fisheries & Oceans

Translation Bureau No. / Notre dossier nº: 1655883

Branch or Division / Direction ou Division: Scientific Information & Publications

Translator (Initials) / Traducteur (Initiales): H.N. / PS

Person requesting / Demandé par: Anna Oxley

JUL 17 1985

Your Number / Votre dossier nº:

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISEE
Information seulement

Date of Request / Date de la demande: 27/05/85

Canada

SEC 5-111 (B4-10)

Secretary of State / Secrétariat d'État

MULTILINGUAL SERVICES DIVISION – DIVISION DES SERVICES MULTILINGUES

TRANSLATION BUREAU / BUREAU DES TRADUCTIONS

Client's No.–N° du client	Department – Ministère	Division/Branch – Division/Direction	City – Ville
	Dept. of Fisheries & Oceans	Scientific Information & Publications Branch	Ottawa
Bureau No.–N° du bureau	**Language – Langue**	**Translator (Initials) – Traducteur (Initiales)**	**JUL JUIL 17 1985**
1655888	Japanese to English	H.N. / PS	

Bulletin of the Tokai Region Fisheries Research Laboratory,

No. 107, March 1982

STUDY ON THE SEVERAL CHEMICAL TESTS FOR ESTIMATING THE QUALITY OF CANNED PRODUCT - II

ON THE CANNED SARDINE AND MASU-SALMON

Haruka IIDA, Koji NAKAMURA, Toshio TOKUNAGA, Kooichi SATO*, Chimaki HOSHINO*, Shigezo TERANO*, and Takeshi FURUKAWA*

Abstract: In the previous paper, characteristics of several chemical tests for estimating the relation between the freshness of raw material and canned product were reported using mackerel as material. And it was found that IMP ratio, DAM ratio (DMA-N/TMA-N), ethanol content, histidine ratio (free histidine/total free amino acid) were useful to estimate the relation between the quality of raw materials and canned products.

This stury was carried out to find out the effect of difference of fish species on the usefulness of these chemical tests using sardine and masu-salmon as materials.

The results obtain were as follows;

1) Determination of DMA-N ratio, IMP ratio, histidine-N ratio and ethanol content in canned products were useful index for estimating the quality of raw materials. But, the values of DMA-N ratio were different depending on the kind of fish. And usefulness of IMP ratio for estimating the quality was limited to the stage of initial change in freshness, on the contrary, ethanol content was useful in the later stages of storage. The usefulness of histidine-N ratio as an index for estimating the quality of raw material was limited to red meat fish.
2) Quality of raw materials used for canning could not be estimated by determanation of histamine, volatile carbonyl compounds and volatile sulphur compounds.
3) Several commercial canned products were analyzed practically by these chemical tests. And the nature of raw materials used for canning were evaluated by considering the results obtained.

Received on December 11, 1981. The Tōkai Region Fisheries Research Laboratory work A No. 751.

* Tōkyō Agriculture and Forestry Standards Inspection Station. 4-4-7 Kōnan, Minato-ku, Tōkyō, Japan Postal Code 108.

Canada

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISEE
Information seulement

SEC 5-25 (Rev. 82/11)

In the previous paper[1], mackerel of various degrees of freshness was bottled and various chemical determinations were carried out, in order to evaluate the quality of the bottled and canned products. As is already widely known, the quality of bottled and canned products is greatly influenced by the freshness of the raw fish used. Therefore, an estimation of the freshness of the fish used for processing is most effective in evaluating the quality of bottled and canned products. The results of the previous report indicated the possibility of estimating the freshness of the fish used as material by determining the IMP ratio, ethanol content and the histidine-N ratio of the canned products.

In this report, the results of experiments conducted in a similar manner using sardine and masu-salmon are described in order to investigate the difference in the values obtained for these chemical determinations due to the differing fish species. Sardine was selected to correspond to the mackerel of the previous report as the red-flesh fish and the masu-salmon was selected as a non red-flesh fish which has traditionally been used as the raw material for canning. In addition, the results of analysis conducted on the various commercially available canned products using the methods discussed in this paper are also reported here.

SAMPLES AND EXPERIMENTAL METHODS

Samples: Fresh sardines purchased at the Tokyo Tsukiji

Central Market and defrosted masu-salmon from the Sea of Japan frozen on board the ship were stored in ice for 15 days and were used for the experiment as needed.

10 - 12 sardines (average body weight 75 g) were used for each experiment. After removing heads, viscera and tails, they were cut crosswise into 3 cm slices, mixed in order to avoid the differences due to the different parts of the fish as well as to the individual fish, and were then bottled in 60 g portions for experimental use, in a manner similar to that of the mackerel of the previous report.

2 masu-salmon (average eviscerated weight 530 g) were used each time. After being filleted, they were cut into 3 cm cubes, mixed well and then bottled in 60 g portions in a similar manner.

Methods of steam processing and the sterilization by heating of the bottled products and the method of preparation of the samples for analysis were the same as those of the previous report.

Method of Analysis: The organoleptic test, DMA-N ratio, IMP ratio, histidine-N ratio, ethanol content, aldehyde content and volatile sulphur compounds were determined in the same manner as in the previous report. Histamine was determined by the OPT fluorescence method[2]. Free amino acids were analysed by the GLC method as a heptafluorobutyric anhydride derivative after they were first separated using the amber light CG 120, and then butyl-esterified. The analytical

conditions used were as follows: apparatus, Shimazu GC-4BM; detector, FID; column, 2.6 mm x 2 m glass column; filler, 5% silicon OV-17; Column temperature, after maintaining it at 100°C for 4 minutes it was raised to 250°C at a rate of 5°C/min; injection port temperature, 250°C; carrier gas, N_2 at 50 ml/min; and the amount of sample injected was 2 µl. In addition, phenanthrene was used as the internal standard.

RESULTS AND DISCUSSION

Organoleptic Evaluation of the Raw Materials and Processed Products: The results of the organoleptic evaluation of raw fish stored in ice and the products bottled at various stages are given in Table 1.

Although sardines stored at 1 - 3°C in a constant temperature container were found to develop a bad odour associated with deterioration on the fourth day[3], in these experiments they were found to be satisfactory for consumption up to the sixth day due to the fact that enough ice was provided and that these fish were large. In making the organoleptic decisions on the products, the scoring standard of the Japanese Agricultural Standard (JAS) was followed using the aroma and the taste as the main object and using 5 classifications going from 5 to 1 where 5 means good and 1 means very inferior. With this scoring method, the products having the score of 5 to 3 are said to be acceptable for consumption. The organoleptic scores for the products bottled using sardines stored in ice up to 6 days were found

to be above 3. However, by the eighth day, the raw fish was found to have developed a slight odour of deterioration, and softening of the flesh was observed. The score of the product at this point was found to be 2 (inferior smell and taste). After the eighth day deterioration in freshness was found to progress and by the 15th day the putrid smell as well as the slime on the body surface was found to develop and the score of the product was judged to be 1.

With the masu-salmon, an unpleasant odour was not detected in the raw fish until day 8, and the softening of the flesh was observed starting on day 8. Although a slight fishy odour was detected in the raw fish by day 10, the organoleptic score of the bottled product at this time was still 3. By day 12, an initial putrid smell was detected in the raw fish and by day 15 the putrid smell as well as the slime produced on the body surface were observed and their organoleptic scores for products made on these days were found to be 2 and 1, respectively.

In this manner, whereas with sardines a decline in the appearance of freshness of the raw fish immediately resulted in unacceptable scores of 2 or 1 for the products, in masu-salmon there was a slight discrepancy between the freshness of the raw fish and its product scores. This is caused by the differences in the amino carbonyl reactions due to different fish species. An additional cause is the fact that, whereas the organoleptic evaluation of raw fish is

mainly based on the odour emitted by the outer skin and the viscera, the product evaluation is based on the smell and the taste of the interior. Therefore, it is supposed that the evaluation results of the former is immediately manifested in the scoring of the latter in a sardine which has a small body but is manifested a bit later in a masu-salmon which has a large body. 14

Quality Evaluation using the DMA-N Ratio: The fact that the DMA-N ratio is useful in evaluating heated processed marine products was stated in the previous report. The relationship between the DMA-N ratio of bottled sardines and masu-salmon and the length of time that the raw fish was stored in ice is given in Fig. 1. In both fish species the values for the products processed from very fresh raw fish were found to be around 20%, this being lower than the 30% found for the mackerel of the previous report. A fairly constant value was obtained with sardines for up to 8 days but the value was found to decrease after day 10. On the other hand, with masu-salmon the values were found to gradually decrease up to day 12 and on day 15 they were found to be greatly reduced when the decomposition was obvious.

With regards to the DMA-N ratio of the products, it was previously observed that there was little change at the stage where canned tuna[4], bonito[4], and mackerel[1] were prepared from raw fish of relatively good freshness but from the start of the decline in the freshness of the raw material

it was found to decrease rapidly in near rectilinear fashion. Similar results were obtained with the sardines and masu-salmon of this study. However, in this study it was found that the DMA-N ratio of the products processed from the raw material in day 0 was found to be 20% in spite of the freshness of the raw material whereas with the tuna products it was reported that the quality of the raw material is good when the DMA-N ratio is above 40% and quite inferior when it is below 20%[4]. Therefore, it was felt that, when considering the DMA-N ratio, a same criterion cannot be used for many fish species because the DMA-N ratio varies depending on the species of fish used in evaluating the raw fish with which the products were made.

Quality Evaluation using Histamine: Changes in the histamine content of sardines raw and steam processed at various stages of freshness as well as the histamine content of masu-salmon on day 15 are given in Fig. 2. The histamine content of sardines was found to be increased little from the initial value of below 0.5 mg/100 g to the 10th day. However, it was found to be rapidly increasing after day 10 when the decomposition became severe. With masu-salmon, on the other hand, it was found to remain at a low level until day 15.

In this manner, there are instances in which the histamine content does not increase even when the freshness has declined considerably even in red-fleshed fish, which contain a large amount of free histidine, if it is stored at

a low temperature[5)-7)]. On the other hand, the production of histamine was hardly detected in masu-salmon, which has a small amount of free histidine. From these results, the quality evaluation of the raw material or its product using histamine content is considered to be difficult.

When the effect of heating was considered, it was found that the histamine content was slightly increased after the steam processing but the amount of increase was found to be small.

Quality Evaluation using the IMP Ratio: The periodic changes in the IMP ratio of raw fish and the effect of heating are given in Fig. 3. Although the IMP ratio of sardines was found to decrease with the length of storage of the raw fish its tendency to decrease was found to be more gradual than that of the mackerel of the previous report. However, that of masu-salmon was found to be even more gradual. The IMP ratio of the processed products were found to decrease almost rectilinearly up to day 8 in sardines and day 5 in masu-salmon but the changes after that were found to be small even though freshness was deteriorating.

However, heating was found to decrease the IMP ratio in sardines and this tendency was found to be great during the period when fish was still fresh. In masu-salmon, a decrease in the IMP ratio caused by heating was observed while the fish was very fresh, however, a tendency for it to increase was observed after a decline in freshness. In large

fish, such as bonito and tuna, there are instances where the decomposition of IMP takes place while the temperature is being raised to the point where the oxygen activity in the interior of the flesh is lost. However, because thinly sliced meat as well as small bottles were used in this experiment, the effect of oxygen on the decrease of the IMP ratio due to heating is considered to be small.

As was mentioned in the previous report, even though a change in the IMP ratio is considered to be useful in the quality evaluation of products processed from raw materials of very fresh quality to those considered to be slightly less fresh quality, we feel that it is not always appropriate for use in evaluating the quality of products processed with raw fish at a advanced stage of decline in freshness because a change in the IMP ratio becomes less as the decline in freshness progresses.

The IMP ratio of sardines at the initial stage of storage was found to be around 85%, which was consistent with that of the mackerel of the previous report, but that of masu-salmon was found to be at a lower level of about 55%. With masu (trout) species, there has been a report[8], besides this one, of an example of a considerably low IMP ratio found for the raw material on acquisition but the reasons for this has not been clarified.

Quality Evaluation using Histidine-N Ratio: The histidine-N ratio of sardine and masu-salmon stored in ice, and the

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISEE
Information seulement

effect of steaming and bottling of these fishes at respective stages of storage on histidine-N ratio are given in Fig. 4.

With sardines, the histidine-N ratio was found to decrease almost rectilinealy with the length of storage of the raw fish and its value was found to be around 60% when 16
the fish was fresh, around 40% when it was slightly less fresh, and 30 - 20% when deterioration was apparent. These figures are consistent with those found for mackerel in the previous report.

With masu-salmon, on the other hand, the effect of the length of time the raw fish was stored was hardly noticeable, with the histidine-N ratio staying at a constant level of 15 - 20%.

During steam processing or sterilization by heating, the histidine-N ratio of masu-salmon was found to show a tendency to decrease, however, consistent changes caused by these respective processes were not observed with sardines.

From the results obtained here, as well as in the previous report, it is thought that the histidine-N ratio is very useful in the evaluation of freshness over a wide range of length of storage, as long as this application is limited to the evaluation of red-flesh fishes, such as sardines and mackerel, containing a large amount of free histidine.

The free amino acid gas chromatograms of sardines at day 0 and day 15 of storage are given in Fig. 5. As can be seen from these, many amino acids, such as alanine, glycine,

leucine, and glutamic acid, were found to increase as the freshness of the stored samples declined while histidine was found to be greatly decreased. In this manner, the amount of many amino acids are increased after death due to autolysis and to the action of proteinase contained in cells, whereas histidine is decreased during the storage in ice because, we think, its decomposition to histamine and urocanic acid is rapid. Free histidine was found to be reduced by about 600 mg/100 g, from a value of about 800 mg/100 g at the start of storage to 200 mg/100 g on day 15. However, the production of histamine during this period was about 12 mg/100 g. This leads us to think that a corresponding amount of urocanic acid was produced but this was not investigated in this study. The changes in the histidine-N ratio of sardines given in Fig. 4 was reconfirmed by these gas chromatograms.

Quality Evaluation using Ethanol Content: Changes in the ethanol content during storage in ice are given in Fig. 6. As explained in the previous report, because changes in ethanol content caused by heating at each stage of processing was found to be small, the values obtained for the raw material, the steam processed sample and the heat sterilized sample at each stage of freshness were given as a range.

With sardines, the values obtained were found to be 1 - 2 ppm up to day 6 but by day 8 when the signs of deterioration of raw fish were detected and when the product

score was 2 it was found to be increased to 5-7 ppm and was found to be rapidly increasing as the deterioration progressed.

With masu-salmon, on the other hand, the ethanol content was found to remain at a low level of 0.7-1.5 ppm up to the 10th day, then to increase to around 3 ppm on the 12th day, when initial raw material decomposition set in and when the product score was 2, and was then found to suddenly increase to around 18 ppm on the 15th day. In this way, the values obtained for the ethanol content were found to be in good agreement with the results of the organoleptic test, after the deterioration of the raw material was detected. Furthermore, the values obtained for these samples at the initial stage of deterioration were consistent with the ethanol content of 3-5 ppm used as the criterion for the deterioration of fishes, such as sardine, mackerel, cod, and saurel, reported previously[3]. However, because ethanol is mainly a product of micro-organisms, the ethanol content before multiplication of micro-organisms is fairly constant. It follows that an estimation of freshness prior to the appearance of the initial signs of deterioration is not possible using the ethanol content.

Quality Evaluation using Volatile Carbonyl Compounds: Changes in the amount of ethanal and propanal found in sardines stored in ice are given in Fig. 7 and those found in masu-salmon are given in Fig. 8. Previously, the authors

have observed that the amount of carbonyl compounds contained in whole dried sardines being stored frozen increased with time[9)-10)], however, this change was not observed in this experiment in which the samples were stored in ice.

Both in sardines and masu-salmon, the level of ethanal was found to be low and to be restricted within a fairly constant range, and, if limited to processed products, was found to show a constant value throughout the duration of storage in ice. Moreover, it was found that heating caused very little change in the ethanal level.

Propanal was found to show complex changes for the duration of storage in ice: it was found to be increased greatly by heating but no definite tendency was observed.

It was felt that these low-molecule carbonyl compounds were produced mainly by the oxidation of lipids. However, it is thought that the carbonyl compounds were found to change at a low level, as seen in the figures, because when samples were stored in ice, unlike when they are frozen, these compounds are lost by evaporation from the body surface of the fish, by dissolving into the water from the melted ice used for cooling, and by reactions with other components taking place more rapidly due to storage in ice having a higher temperature than freezing.

For this reason, volatile carbonyl compounds are not likely to be used as the index for the evaluation of the quality of products processed from fish stored in ice.

On the other hand, although the level of ethanal was found to increase with a short period of frozen storage[3], when the results of this study are considered, heating was found to have a small effect on it and storage in ice did not increase its level. Therefore, it is possible that the ethanal level could be used to judge whether the fish used as raw material for processing was frozen or not.

Quality Evaluation using Volatile Sulphur Compounds: The changes over time in the amount of volatile sulphur compounds contained in sardines for different methods of processing are given in Table 2. In the case of raw material, although hydrogen sulphide and methyl mercaptan showed a tendency to increase with the length of storage, the quantities found were very minute in both, as well as in dimethyl sulphide. Even though the levels of hydrogen sulphide and dimethyl sulphide were found to increase with heating, no definite tendency was observed. The results of similar determinations carried out using masu-salmon are given in Table 3. In masu-salmon, although methyl mercaptan was found to show a tendency to decrease during storage of the raw fish, which is opposite to that found in sardines, no definite tendency was observed in the heated product. In any case, it is difficult to estimate the freshness of the raw material from the amount of sulphur compounds contained in the processed products because their amount vary greatly depending on factors such as heating and amount of the precursors of these compounds.

Summary of the Usefulness of Various Analytical Values in the Evaluation of Quality: These experiments were carried out with the aim of estimating the freshness of the raw fish used for processing based on the values obtained from the analysis of the components of the bottled and canned products. The usefulness of these analytical values for the evaluation of quality was examined. The results thus obtained are compiled in Table 4.

The DMA-N ratio and histidine-N ratio are both useful indices since not only did the values obtained for the raw material approximate those obtained for bottled products but also they were found to be highly correlated to the organoleptic scores. However, their weaknesses lie in the fact that the values of the former are dependent on the species of fish and that the usefulness of the latter is limited to fish species with high free histidine contents, such as red-flesh fish. Moreover, there is a danger that the histidine-N ratio cannot be used when seasonings, such as sodium glutamate*, have been added.

Although the IMP ratio and the ethanol content were found to be little affected by heating and to be in good agreement with organoleptic scoring, a variation in the values of the former was found to be great at the stage of relatively good freshness, though the amount of change was found to be less with the decline in freshness. On the other hand, the latter was found to vary more as the deterioration

---

* translator's note : literally "glutamic acid soda"

progressed. In this manner, the usefulness of both of these tests as indices are limited to a narrow range of freshness, the early and late stages of storage. Moreover, ethanol content was found to be not applicable to the evaluation of quality since the values obtained for it were found to be extremely large when fermented seasonings, such as soy sauce and miso, were added, as illustrated later by example.

The effect of heating on the histamine content of sardines was small. Even with fish containing a large amount of free histidine, such as sardines, the production of histamine was found not to take place easily when raw fish was stored at the relatively low temperature of 0 - 1°C but it was found to take place only after decomposition became obvious. It stayed at a low level throughout in fish species with a low free histidine content. It follows that histamine content cannot be used as the criterion for the evaluation of 21
quality of raw fish stored at a relatively low temperature or products processed from it.

No definite effect of heating was found with volatile carbonyl compound content or with sulphur compound content nor was any close correlation of these values to the organoleptic scores observed. Therefore, the evaluation of quality using these analytical values is difficult. However, the ethanal level, in conjunction with analytical results of other components, can probably be used as an index for judging whether the raw fish used for processing was frozen,

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISEE
Information seulement

since the ethanal level was found to increase while fish was stored frozen and it was little affected by heating.

Application of these Tests on Commercial Canned Products:

The results of the analysis of commercial canned products are given in Table 5. However, canned products in tomato sauce, though produced in Japan, are for export and, therefore, are not commercially available in Japan. When determination was made for the liquid separately from the solid, the values obtained for the hypoxanthine (Hx) ratio, IMP ratio and histamine content were found to be about same in both cases. Even with other tests, no great variation was found for the values obtained, with 1 or 2 exceptions.

With regards to the aldehyde content, some samples were found with values of 20-30 ppm, which were much higher than the usual value[11]. These samples should have a strange smell but no strange odour was noticed even when they were tasted. This must be due to masking by the components found in the seasoning liquid.

Since canned mackerel packed in water was found to have a low IMP ratio and relatively high ethanol content, it is estimated that the freshness of the raw fish used must have improved.

Since canned mackerel and sardines, both in tomato sauce, were found to have high IMP ratios and low ethanol contents, the freshness of the raw material was assumed to be good. In spite of this, their ethanal content was found to

be high. Since the level of ethanal increases during freezing, these canned products were thought to have been processed using frozen fish as the raw material.

Although canned Sakhalin masu packed in water was found to have a low IMP ratio, masu-salmon of this study was also found to give results of around 50% from the start of the experiment. It has been reported that even though the IMP ratio of canned masu is found to be lower than that of canned mackerel, no difference was observed in the organoleptic evaluations of the two[8]. Therefore, it cannot be said that the freshness of the raw material used for the canned masu product was inferior just because its IMP ratio was lower than that of canned fish of other species.

Ethanol contents of seasoned canned sardines and tuna were found to be unusually high. This is assumed to be caused mainly by soy sauce used for seasoning. Therefore, 23
ethanol content cannot be used as the index for evaluation of freshness of the raw material for the products that contain brewed seasonings containing ethanol, such as soy sauce, miso and mirin (sweet rice wine for cooking). For this reason, ethanol content values for these products were put in parentheses in the table.

The above findings indicate that, when estimating freshness of the raw material by analysing components of the products, comprehensive evaluation should be conducted by using many analytical values and by taking into consideration

factors, such as the species of fish used as raw material, stage of freshness, and presence of additives.

Table 1. Organoleptic inspection of raw fish and canned product.

		Organoleptic survey of raw fish	Organoleptic score* of canned product
Sardine	Days in ice 0	Very fresh, pracictically no odor	5
	3	Fresh	4
	5	Fresh	4
	6	Fresh Slight "fishy odor," edible enough	3
	8	Indication of decoomposition	2
	10	Initial decomposition	2
	12	Decomposition	2
	15	Putrid, skin was slimy	1
Masu Salmon	Days in ice 0	Normal odor	5
	3	Normal odor	4
	6	Normal odor	3
	8	Normal odor, meat was softened	3
	10	Slight fishy odor"	3
	12	Initial decomposition	2
	15	Putrid, skin was slimy	1

* Scores were given by JAS

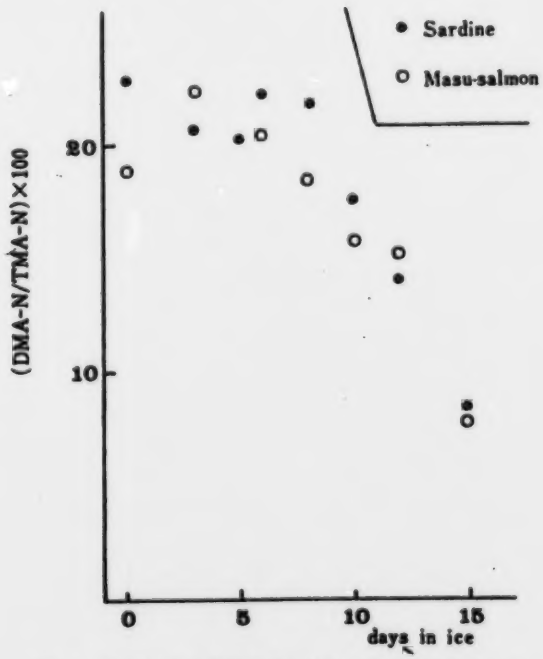

Fig. 1. Changes in DMA-N ratio* of canned products.
*** DMA-N ratio: (DMA-N/TMA-N) × 100**

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISEE
Information seulement

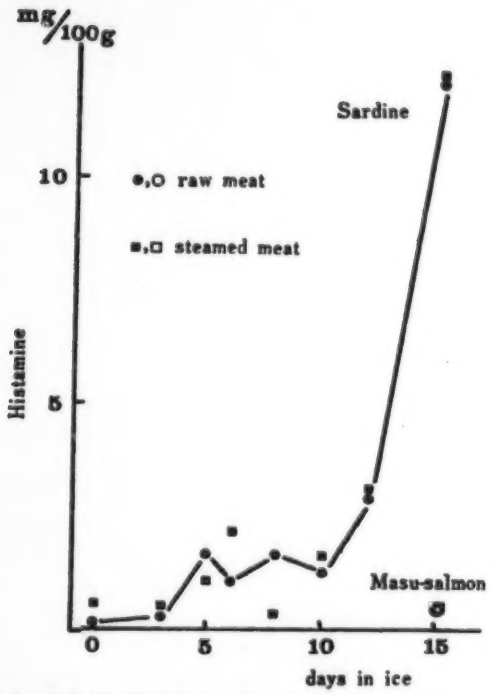

Fig. 2. Periodic changes in histamine content of raw fish during storage in ice, and effect of heat processing at 100 °C (steamed meat) on the histamine.

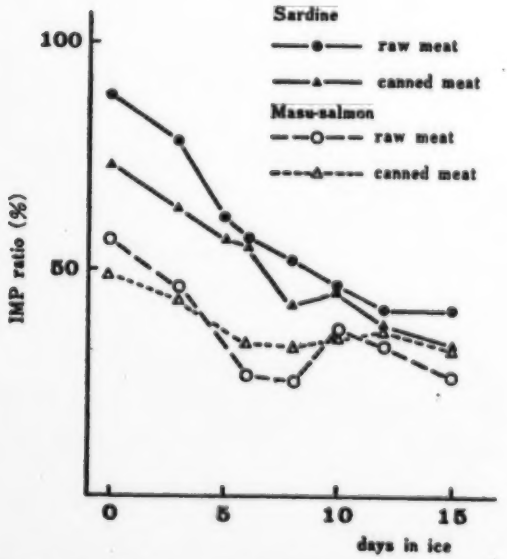

Fig. 3. Periodic changes in IMP ratio* of raw fish and the products during storage in ice.
* IMP ratio: (IMP/Hx+HxR+IMP) × 100

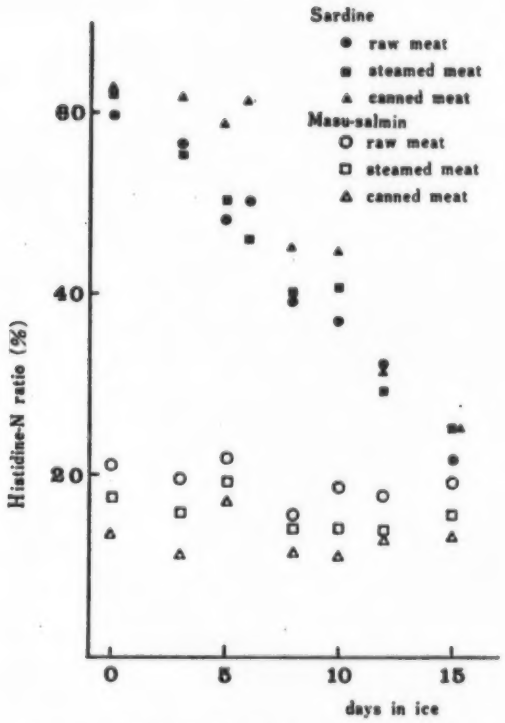

Fig. 4. Periodic changes in histidine-N ratio* of raw fish during storage in ice, and effect of heat processing at 100 °C (steamed) and 115 °C (canned) on the histidine-N ratio.

* histidine-N ratio: (free histidine-N/total free amino acid-N) × 100

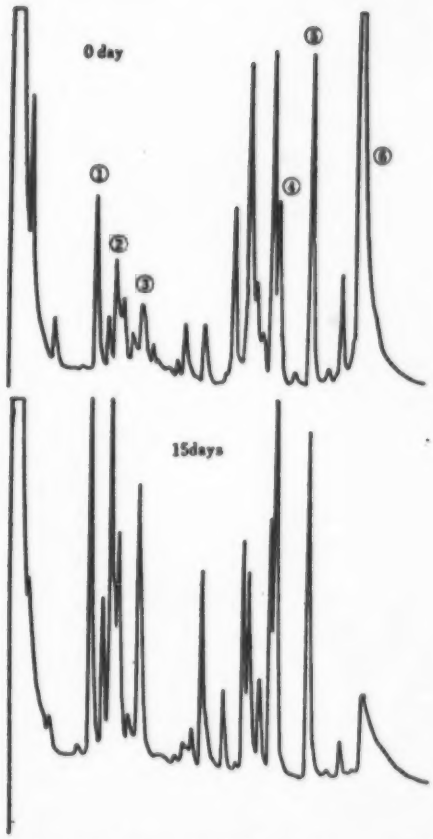

Fig. 5. Comparision in free amino acid composition of sardine stored for 0 and 15 days in ice.
1: alanine 2: glycine 3: leucine 4: glutamic acid
5: internal standard 6: histidine

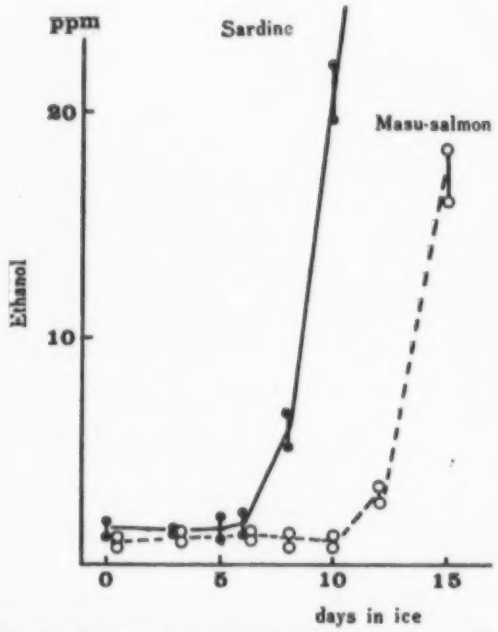

Fig. 6. Periodic changes in ethanol content of raw fish and the products storage in ice.

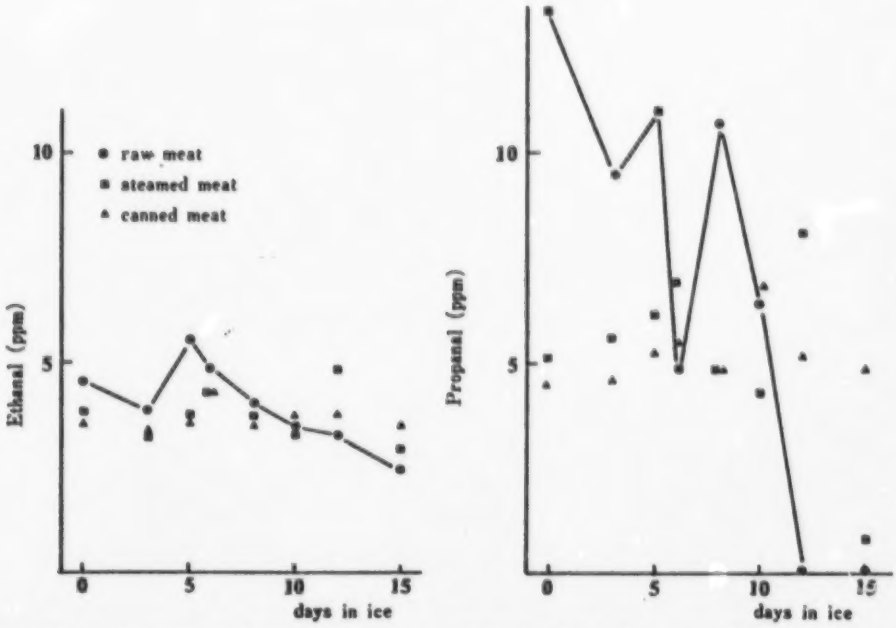

Fig. 7. Periodic changes in calbonyl compounds of raw sardine during storage in ice, and effect of heat processing at 100°C (steamed) and 115°C (canned) on the calbonyl compounds.

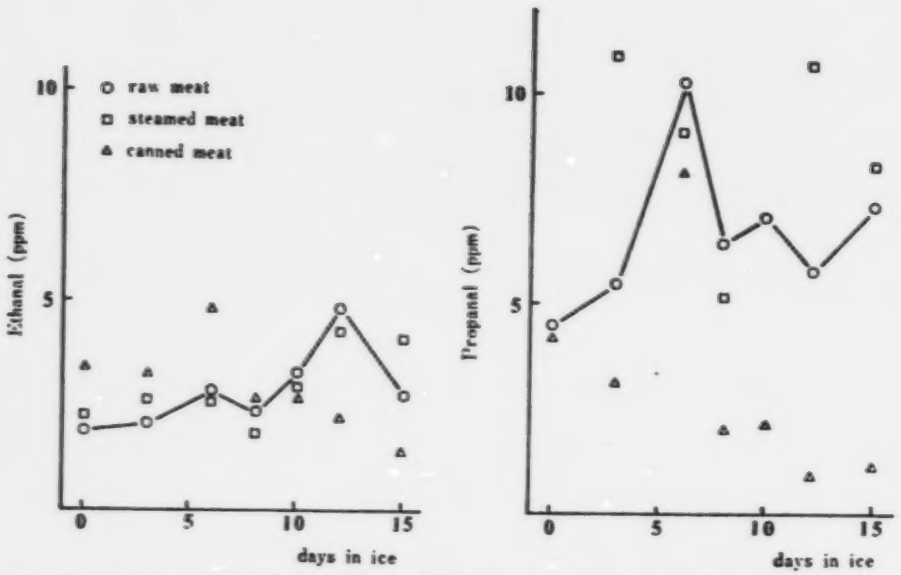

Fig. 8. Periodic changes in calbonyl compounds of raw masu-salmon during storage in ice, and effect of heat processing at 100°C (steamed) and 115°C (canned) on the carbonyl compounds.

Table 2. Changes in contents of volatile sulpher compounds in raw sardine during storage in ice, and the effect of heat processing at 100°C (steamed) and 115°C (canned) on the contents of volatile sulphur compounds.

	Days in ice	Hydrogen sulphide	Methyl mercaptan	Dimethyl sulphide
		ng/g		
Raw meat	0	Tr	Tr	Tr
	3	Tr	Tr	Tr
	5	Tr	Tr	Tr
	6	2	Tr	Tr
	8	2	4	Tr
	10	Tr	3	Tr
	12	2	3	Tr
	15	6	5	Tr
Steamed meat	0	3	Tr	Tr
	3	3	Tr	Tr
	5	2	Tr	Tr
	6	2	Tr	Tr
	8	2	Tr	Tr
	10	3	2	Tr
	12	4	Tr	Tr
	15	15	Tr	Tr
Canned meat	0	18	5	49
	3	23	7	1600
	5	10	Tr	31
	6	4	Tr	14
	8	8	Tr	36
	10	4	Tr	22
	12	12	Tr	50
	14	45	6	63

Table 3. Changes in contents of volatile sulphur compounds in raw masu-salmon during storage in ice, and the effect of heat processing at 100°C (steamed) and 115°C (canned) on the contents of volatile sulphur compounds.

	Days in ice	Hydrogen sulphide	Methyl mercaptan	Dimethyl sulphide
		ng/g		
Raw meat	0	22	420	Tr
	3	7	100	6
	6	4	222	6
	8	11	270	9
	10	3	160	Tr
	12	Tr	95	Tr
	15	Tr	74	Tr
Steamed meat	0	27	216	5
	3	Tr	39	15
	6	Tr	24	Tr
	8	5	28	8
	10	5	20	Tr
	12	5	19	Tr
	15	7	19	Tr
Canned meat	0	18	69	102
	3	15	48	3000
	6	Tr	32	38
	8	29	246	132
	10	33	654	126
	12	12	Tr	56
		12	Tr	123

Table 4. Usefulness of chemical tests for estimating the freshness of material use for canning.

	Usefulness	Chracteristics
DMA-N ratio	Comparatively high	Variable depend on kind of fish.
Histamine content	Low	Specially in fish stored at low temp.
IMP ratio	High	For good quality fish.
Histidine ratio	High in red flesh fish	Not applied for white flesh fish.
Ethanol content	High	For poor quality fish.
Aldehyde content	Low	Usefull for frozen fish
Volatile sulphur content	Low	

Table 5. Analytical results of some commercial canned products.

		Hx ratio (%)	IMP ratio(%)	Histamine mg/100 g	DMA/ DMA × 100	Ethanol ppm	Aldehyde ppm Ethanal	Propanal
Mackerel (Boiled)	solid	10.4	38.7	0.54	34.6	5.7	13.8	—
	liqud	9.1	40.3	0.32	19.3	4.0	6.0	1.3
Mackerel (In tomato sauce)	solid	8.8	54.7	0.36	26.5	1.3	12.5	6.9
	liquid	10.8	50.5	0.27	24.6	3.4	29.3	3.0
Pink Salmon (Boiled)	solid	12.2	43.1	—	24.9	1.0	2.6	4.0
	liquid	10.6	44.3	—	23.8	0.5	2.0	1.0
Sardine (In tomato sauce)	solid	6.9	70.7	0.70	33.0	0.1	25.3	12.0
	liquid	7.3	69.5	0.32	27.2	0.2	21.5	2.4
Sardine (Seasoned with shoyu)	Solid	7.3	67.9	1.30	32.5	(414)	4.8	trace
	liquid	8.6	69.5	1.25	24.8	(434)	7.5	—
Tuna (Seasoned With shoyu)	solid	16.3	41.6	1.07	39.4	(837)	7.7	—
	liquid	16.0	47.4	1.04	33.2	(829)	9.8	—

BIBLIOGRAPHY

1) 徳永俊夫・飯田 遙・中村弘二・寺野重造・古川 剛・佐藤錠一・星野智巻：本誌，107，1—10 (1982).
2) Peter A. Lerke and Laurence D. Bell : *J. Food Sci.*, 41, 1282—1284 (1976).
3) 飯田 遙・徳永俊夫・中村弘二・太田佳子：本誌，104，83—90 (1981).
4) 徳永俊夫：本誌，101，1—129 (1980).
5) Edmunds W.J. and Eintenmiller R.R. : *J. Food Sci.*, 40, 515—519 (1975).
6) Fernández-Salguero J. and Mackie I.M. : *J. Food Technol.*, 14, 131—139 (1969).
7) Hardy R. and Smith J.G.M. : *J. Sci. Food Agric.*, 27, 595—599 (1976).
8) 藤井 豊・広瀬孔孝・手塚 久・野口栄三郎：日水誌，35，665—671 (1969).
9) 飯田 遙・中村弘二・徳永俊夫：本誌，98，77—85 (1979).
10) 飯田 遙・中村弘二・徳永俊夫：本誌，98，87—92 (1978).
11) 三輪勝利：本誌，81，185—269 (1975).

1) Toshio TOKUNAGA, Haruka IIDA, Kōji NAKAMURA, Shigezō TERANO, Takeshi FURUKAWA, Kōichi SATŌ and Chimaki HOSHINO: this journal, 107, 1-10 (1982).

3) Haruka IIDA, Toshio TOKUNAGA, Kōji NAKAMURA, and Keiko ŌTA: this journal, 104, 83-90 (1981).

4) Toshio TOKUNAGA: this journal, 101, 1-129 (1980).

8) Yutaka FUJII, Yoshitaka HIROSE, Hisashi TEZUKA and Eisaburō NOGUCHI: Nissui-shi (Bulletin of the Japanese Society of Scientific Fisheries), 35, 665-671 (1969).

9) Haruka IIDA, Kōji NAKAMURA, and Toshio TOKUNAGA: this journal, 98, 77-85 (1979).

10) Haruka IIDA, Kōji NAKAMURA, and Toshio TOKUNAGA: this journal, 98, 87-92 (1978)

11) Katsutoshi MITSUWA: this journal, 81, 185-269 (1975).